# DEPARTMENT OF MATHEMATICS AND PHYSICS

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The Department of Mathematics and Physics is home to a vibrant community of scholars who are passionate about exploring the fascinating intersection between mathematics and physics. We offer a wide range of undergraduate and graduate programs, including majors in Mathematics, Statistics, Physics, and Physical and Applied Sciences, as well as advanced degrees in Mathematics and Physics.

At the undergraduate level, we offer a comprehensive curriculum designed to provide students with a strong foundation in the core concepts and principles of mathematics and physics, from calculus and linear algebra to quantum mechanics and thermodynamics, taught by experienced faculty members who are dedicated to providing engaging and intellectually challenging instruction.

Our graduate programs in Mathematics and Physics are designed for students who are looking to take their knowledge and skills to the next level. Graduate students have the opportunity to work closely with faculty members on cutting-edge research projects, and many go on to successful careers in academia, industry, and government.

## Transfer Students

Transfer students must take at least 12 hours of 300/400 level coursework in the College of Science and at least 15 hours in their major field, including at least nine hours of 300-400 level coursework at Marshall University.

## General Education And Placement

The American College Test (ACT) score in Mathematics (or equivalent SAT) is utilized for the placement of students. Relevant information regarding such placement is included under prerequisites in the Courses of Instruction. Students wishing to challenge their placement in a mathematics course may do so by taking the Accuplacer Placement Exam administered by University College.

Students with prior credit for any college algebra course (i.e., MTH 127 College Algebra-Expanded, MTH 130 College Algebra, or MTH 132 Precalculus with Sci Applica) may not receive credit for any other of these courses.

A student enrolled at Marshall may receive credit for certain courses in mathematics by successfully completing the appropriate examination of the College Level Examination Program (CLEP).

Advanced placement in mathematics is granted on the basis of Educational Testing Service Advanced Placement Test scores.

On the Calculus AB Examination:

- A score of 3 on AB provides students credit for MTH 132 Precalculus with Sci Applica.

- A score of 4 or 5 on AB provides students credit for MTH 130 College Algebra and MTH 229 Calculus/Analytic Geom I (CT).

On the Calculus BC examination:

- A score of 3 on BC provides credit for MTH 229 Calculus/Analytic Geom I (CT).
- A score of 4 or 5 on BC provides credit for MTH 229 Calculus/Analytic Geom I (CT) and MTH 230 Calculus/Analytic Geom II.

## Courses

🐃 - General Education Course

### Mathematics

**MTH 102 Prep for College Math B**               **4 Credit hours**
A mastery-based course that will prepare students for college algebra.
**Grade Mode:** Normal Grading Mode

**MTH 102B Abr Prep for College Math B**               **1 Credit hour**
An abridged mastery-based course that will prepare students for College Algebra.
**Pre-req:** MTH 121 with a minimum grade of D or MTH 121B with a minimum grade of D.
**Grade Mode:** Normal Grading Mode

**MTH 121 🐃  Concepts and Applications (CT)**        **3 Credit hours**
Critical thinking course for non-science majors that develops quantitative reasoning skills. Topics include logical thinking, problem-solving, linear modeling, beginning statistics and probability, exponential and logarithmic models, formula use, and financial concepts.
**Pre-req:** ACT Math with a score of 19 or SAT Mathematics Before Mar. 16 with a score of 460 or Placement Math with a score of 100 or Placement Math After SP17 with a score of 101 or Placement Math SP20 with a score of 241 or Math Workshop-UC with a score of 100 or MTH 102B with a minimum grade of C or SAT MATH SECTION SCORE with a score of 510.
**Attributes:** Critical Thinking, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 121B 🐃  Cncpts & Apps-Expanded (CT)**        **4 Credit hours**
Critical thinking course for non-science majors that develops quantitative reasoning skills. Topics include logical thinking, linear modeling, statistics and probability, exponential and logarithmic modeling, and financial concepts, with arithmetic review.
**Attributes:** Critical Thinking, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 121H Concepts and Applications**        **3 Credit hours**
**Pre-req:** ACT Math with a score of 21 or SAT Mathematics Before Mar. 16 with a score of 530 or SAT MATH SECTION SCORE with a score of 530.
**Attributes:** Honors
**Grade Mode:** Normal Grading Mode

**MTH 122**  🐃  **Plane Trigonometry**                    **3 Credit hours**
Definitions of circular functions; graphs of the trigonometric functions, trigonometric identities, and applications.
**Pre-req:** ACT Math with a score of 22 or SAT Mathematics Before Mar. 16 with a score of 520 or SAT MATH SECTION SCORE with a score of 540 or Placement Math After SP17 with a score of 103 or Placement Math SP20 with a score of 257 or MTH 127 with a minimum grade of C or MTH 130 (may be taken concurrently) with a minimum grade of C.
**Concurrent PR:** MTH 130
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 127**  🐃  **College Algebra-Expanded**              **5 Credit hours**
A brief but careful review of the main techniques of algebra. Polynomials, rational, exponential, and logarithmic functions. Graphs, equations and inequalities, sequences.
**Pre-req:** ACT Math with a score of 17 or SAT Mathematics Before Mar. 16 with a score of 400 or SAT MATH SECTION SCORE with a score of 460 or Placement Math After SP17 with a score of 101 or Placement Math SP20 with a score of 237 or Placement Math with a score of 100 or Math Workshop-UC with a score of 100 or MTH 102 with a minimum grade of C or MTH 102B with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 130**  🐃  **College Algebra**                       **3 Credit hours**
Polynomial, rational, exponential, and logarithmic functions. Graphs, equations and inequalities, sequences.
**Pre-req:** ACT Math with a score of 21 or SAT Mathematics Before Mar. 16 with a score of 500 or SAT MATH SECTION SCORE with a score of 530 or Placement Math After SP17 with a score of 102 or Placement Math SP20 with a score of 250.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 132**  🐃  **Precalculus with Sci Applica**          **5 Credit hours**
Functions used in calculus including polynomial, rational, exponential, logarithmic, and trigonometric. Systems of equations and inequalities, conic sections, polar and parametric equations, sequences and series, Binomial Theorem.
**Pre-req:** ACT Math with a score of 24 or SAT Mathematics Before Mar. 16 with a score of 560 or SAT MATH SECTION SCORE with a score of 570 or Placement Math After SP17 with a score of 104 or Placement Math SP20 with a score of 263 or MTH 127 with a minimum grade of C or MTH 130 with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 140**  🐃  **Applied Calculus**                      **3 Credit hours**
A brief survey of calculus including both differentiation and integration with applications.
**Pre-req:** ACT Math with a score of 24 or SAT Mathematics Before Mar. 16 with a score of 560 or SAT MATH SECTION SCORE with a score of 570 or Placement Math After SP17 with a score of 104 or Placement Math SP20 with a score of 263 or MTH 127 with a minimum grade of C or MTH 130 with a minimum grade of C or MTH 130H with a minimum grade of C or MTH 132 with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 140H**  🐃  **Applied Calculus Honors**             **3 Credit hours**
A brief survey of calculus including both differentiation and integration with applications. This honors course will also introduce topics from differential equations with applications.
**Pre-req:** ACT Math with a score of 24 or SAT Mathematics Before Mar. 16 with a score of 560 or SAT MATH SECTION SCORE with a score of 570.
**Attributes:** Honors, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 160**  🐃  **Applied Math Reasoning (CT)**           **5 Credit hours**
A critical thinking course in applied mathematical reasoning. Topics include logic, problem solving, linear modeling, beginning statistics and probability, exponential and logarithmic modeling, formula use.
**Pre-req:** SAT Mathematics Before Mar. 16 with a score of 400 or ACT Math with a score of 17 or SAT MATH SECTION SCORE with a score of 460 or Placement Math After SP17 with a score of 101 or Placement Math SP20 with a score of 237 or MTH 102 with a minimum grade of C or MTH 102B with a minimum grade of C or MTH 127 with a minimum grade of C.
**Attributes:** Critical Thinking, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 220**  🐃  **Discrete Structures**                   **3 Credit hours**
Sets, relations, directed and undirected graphs, monoids, groups, lattices, Boolean algebra, and propositional logic.
**Pre-req:** ACT Math with a score of 27 or SAT Mathematics Before Mar. 16 with a score of 610 or SAT MATH SECTION SCORE with a score of 630 or Placement Math After SP17 with a score of 105 or Placement Math SP20 with a score of 276 or MTH 132 with a minimum grade of C or MTH 140 with a minimum grade of C or MTH 229 with a minimum grade of C or MTH 229H with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 229**  🐃  **Calculus/Analytic Geom I (CT)**         **5 Credit hours**
An introduction to calculus and analytic geometry, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including transcendental functions.
**Pre-req:** ACT Math with a score of 27 or SAT Mathematics Before Mar. 16 with a score of 610 or SAT MATH SECTION SCORE with a score of 630 or Placement Math After SP17 with a score of 105 or Placement Math SP20 with a score of 276 or MTH 132 with a minimum grade of C.
**Attributes:** Critical Thinking, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 229H**  🐃  **Calculus I Honors (CT)**              **5 Credit hours**
An introduction to calculus and analytic geometry for honors students, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including transcendental functions.
**Pre-req:** ACT Math with a score of 27 or SAT Mathematics Before Mar. 16 with a score of 610 or SAT MATH SECTION SCORE with a score of 630 or MTH 132 with a minimum grade of C.
**Attributes:** Critical Thinking, Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 230** 🐃 **Calculus/Analytic Geom II**    **4 Credit hours**
A study of the conics and transcendental functions, techniques of integration, improper integrals, indeterminate forms and infinite series.
**Pre-req:** MTH 229 with a minimum grade of C or MTH 229H with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 231** 🐃 **Calculus/Analytic Geom III**    **4 Credit hours**
Analytic geometry of two and three dimensions, partial differentiation, and multiple integrals.
**Pre-req:** MTH 230 with a minimum grade of C.
**Attributes:** Core II Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 300 Intro to Higher Math**    **4 Credit hours**
A transition between elementary calculus and higher mathematics with emphasis on techniques of proofs.
**Pre-req:** MTH 230 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 310 Math for Secondary Educators**    **3 Credit hours**
An integrated study of proof, number, quantity, measurement, algebra, trigonometry, and geometry for secondary mathematics educators. Includes teaching techniques, engagement strategies, assessment analysis, and topics specific to professional educators.
**Pre-req:** MTH 229 with a minimum grade of C or (MTH 140 with a minimum grade of C and MTH 122 with a minimum grade of C).
**Grade Mode:** Normal Grading Mode

**MTH 311 Math for Secondary Educators 2**    **3 Credit hours**
An integrated study of proof, probability, statistics, functions, trigonometry, pre-calculus, and calculus for secondary mathematics educators. Includes teaching techniques, engagement strategies, assessment analysis, and topics specific to professional educators.
**Pre-req:** MTH 229 with a minimum grade of C or (MTH 140 with a minimum grade of C and MTH 122 with a minimum grade of C).
**Grade Mode:** Normal Grading Mode

**MTH 329 Elementary Linear Algebra**    **3 Credit hours**
Systems of linear equations, matrices and determinants, vector spaces, linear transformations, eigenvalues, eigenvectors, and applications.
**Pre-req:** MTH 229 with a minimum grade of C or MTH 229H with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 331 Linear Algebra**    **4 Credit hours**
Vector spaces, matrices and determinants, linear transformations, eigenvalues and eigenvectors, and applications.
**Pre-req:** MTH 300 (may be taken concurrently) with a minimum grade of C.
**Concurrent PR:** MTH 300
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 335 Ordinary Diff Equations**    **3 Credit hours**
A study of differential equations, their solutions, and applications to physical systems, emphasizing closed-form solving methods. Laplace transforms, orthogonal functions, approximation and numerical methods with applications.
**Pre-req:** MTH 230 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 360 Intro to Complex Variables**    **3 Credit hours**
An introductory survey of complex numbers, analytic functions, properties of elementary functions, integrals, series, residues and poles, with a focus on practical applications.
**Pre-req:** MTH 231 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 361 Vector Calculus**    **3 Credit hours**
A course in n-dimensional calculus: the derivative, the integral, and applications. Coordinate-free methods are emphasized.
**Pre-req:** MTH 231 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 400 Structure of Algebra**    **3 Credit hours**
Emphasis on the language of Modern Elementary Algebra. Recommended for pre-service elementary teachers and for elementary and secondary in-service teachers. May not be used for either a degree offered by the Department of Mathematics or for a 7-9 or 7-12 mathematics specialization.
**Pre-req:** MTH 127 with a minimum grade of C or MTH 130 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 401 Structure Modern Geometry**    **3 Credit hours**
Informal development of geometry. Recommended for preservice elementary teachers and for elementary and secondary inservice teachers. May not be used for either a degree offered by the Department of Mathematics or for a 7-9 or 7-12 mathematics specialization.
**Pre-req:** MTH 130 with a minimum grade of C or MTH 127 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 404 Math Methods and Materials**    **3 Credit hours**
Content and content-specific pedagogy for secondary mathematics education majors.
**Pre-req:** Admitted to Teacher ED with a score of 5.
**Co-req:** CI 470
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 405 History of Mathematics**    **3 Credit hours**
A study of the history of mathematics from the time of the ancient Greeks to the end of the nineteenth century.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 411 Mathematical Modeling**    **3 Credit hours**
Students work in teams to construct mathematical models of various real-world situations. Problems to be modeled are drawn from diverse areas of application and use a wide range of undergraduate mathematics.
**Pre-req:** MTH 231 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 415 Partial Differential Equations          3 Credit hours**
Differential equations. Heat Equation, Laplace's Equation, separation of variables, Fourier series, vibrating strings, eigenvalue problems, finite differences, Bessel functions, Legendre polynomials.
**Pre-req:** MTH 331 with a minimum grade of C and MTH 335 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 416 Advanced Differential Equation          3 Credit hours**
Differential equations are studied qualitatively. Topics include the existence and uniqueness of solutions and the behavior of solutions including stability of nonlinear systems, periodic solutions, and approximation using pertubation methods.
**Pre-req:** MTH 300 and MTH 335.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 427 Advanced Calculus I          3 Credit hours**
The number system, limits, sequences, partial differentiation with applications, maxima and minima of functions of several variables. Theory of definite integrals, multiple integrals, line and surface integrals, improper integrals, infinite series.
**Pre-req:** MTH 231 with a minimum grade of C and MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 428 Advanced Calculus II          3 Credit hours**
The number system, limits, sequences, partial differentiation with applications, maxima and minima of functions of several variables. Theory of definite integrals, multiple integrals, line and surface integrals, improper integrals, infinite series.
**Pre-req:** MTH 427 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 430 Topology I          3 Credit hours**
First course in topology. Basics of point-set topology: metric and topological spaces, continuity, connectedness, compactness, products, quotients. Surfaces and simplicial complexes, Euler characteristics.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 431 Topology II          3 Credit hours**
First course in algebraic topology. Homotopy, fundamental group, simplicial homology.
**Pre-req:** MTH 430 with a minimum grade of C and MTH 450 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 440 Graph Th and Combinatorics          3 Credit hours**
This course is designed to introduce students in mathematical sciences to the theorems, techniques, and applications of graph theory and combinatorics.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 442 Numerical Linear Algebra          3 Credit hours**
Direct and iterative methods for numerical solution of linear systems of equations. Eigenvalues and eigenvectors. Error Analysis and norms. Related topics.
**Pre-req:** MTH 331 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 443 Numerical Analysis          3 Credit hours**
The theory and technique of numerical computation involving the difference calculus, the summation calculus, interpolation methods, solution of systems of equations, and methods of solution of ordinary differential equations.
**Pre-req:** MTH 331 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 448 Modern Geometries          3 Credit hours**
Finite geometrics, basic background material for the modern development of Euclidean Geometry, other geometries.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 449 Projective Geometry          3 Credit hours**
Projective Geometry using both synthetic and algebraic methods.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 450 Modern Algebra I          3 Credit hours**
Structure of the abstract mathematical systems; groups, rings, fields, with illustrations and applications from number theory.
**Pre-req:** MTH 300 with a minimum grade of C and MTH 331 (may be taken concurrently) with a minimum grade of C.
**Concurrent PR:** MTH 331
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 452 Modern Algebra II          3 Credit hours**
Continuation of MTH 450.
**Pre-req:** MTH 450 with a minimum grade of C.
**Attributes:** Mathematics
**Grade Mode:** Normal Grading Mode

**MTH 455 Number Theory          3 Credit hours**
A survey of some basic properties of the integers: divisibility (prime numbers, factorization, perfect numbers), congruences (modular arithmetic, linear and quadratic congruences, the Chinese Remainder Theorem), and Diophantine equations.
**Pre-req:** MTH 300 with a minimum grade of C.
**Grade Mode:** Normal Grading Mode

**MTH 480 Special Topics          1-4 Credit hours**
**Attributes:** Mathematics, No Textbook Required
**Grade Mode:** Normal Grading Mode

**MTH 485 Independent Study          1-4 Credit hours**
**Attributes:** Mathematics, No Textbook Required
**Grade Mode:** Normal Grading Mode

**MTH 490 🦬 Internship in Mathematics          2-12 Credit hours**
A supervised internship in an area of mathematics, applied mathematics, or statistics. By permission only.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Capstone Course
**Grade Mode:** Normal Grading Mode

**MTH 491** 🐃 **Senior Seminar**    **2 Credit hours**
Capstone experience in reading, doing writing and speaking mathematics. Student will explore topics related to a theme chosen by the instructor.
**Pre-req:** MTH 300 with a minimum grade of C.
**Attributes:** Capstone Course, Mathematics
**Grade Mode:** Normal Grading Mode

## Physics

**PHY 101** 🐃 **Conceptual Physics**    **3 Credit hours**
Introduces nonscience majors to applications of physics in life. Emphasizes conceptual understanding of basic principles in classical and modern physics. Recommended for science students with no high school physics.
**Pre-req:** (MTH 121 with a minimum grade of D or MTH 127 with a minimum grade of D or MTH 130 with a minimum grade of D or MTH 130E with a minimum grade of D or MTH 132 with a minimum grade of D or MTH 229 with a minimum grade of D or MTH 229H with a minimum grade of D or MTH 203 with a minimum grade of D or MTH 121B with a minimum grade of D) or MTH 130H with a minimum grade of D and PHY 101L (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** PHY 101L
**Co-req:** PHY 101L
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 101L** 🐃 **Conceptual Physics Lab**    **1 Credit hour**
Conceptual Physics Laboratory. A laboratory course designed to include the principles and applications of physics that are introduced in Physics 101. (CR: PHY 101) 2 lab.
**Co-req:** PHY 101
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 190** 🐃 **Overview of Physics (CT)**    **3 Credit hours**
An algebra-based overview of well-established topics studied as part of a major in physics, including classical physics, special relativity, quantum mechanics, particle physics, and cosmology.
**Attributes:** Critical Thinking
**Grade Mode:** Normal Grading Mode

**PHY 201** 🐃 **College Physics I**    **3 Credit hours**
First half of an introduction to physics for life-science students, using algebra and trigonometry, including kinematics and dynamics, force, energy, rotation, fluids, waves, and therma phenomena.
**Pre-req:** (MTH 127 with a minimum grade of D and MTH 122 with a minimum grade of D) or (MTH 130 with a minimum grade of D and MTH 122 with a minimum grade of D) or MTH 132 with a minimum grade of D or (MTH 140 with a minimum grade of D and MTH 122 with a minimum grade of D) or MTH 229 with a minimum grade of D or MTH 229H with a minimum grade of D or MTH 140H with a minimum grade of D and PHY 202 (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** PHY 202
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 202** 🐃 **General Physics I Laboratory**    **1 Credit hour**
Laboratory to accompany PHY 201 or PHY 211, focusing on mechanics concepts and applications.
**Pre-req:** PHY 201 (may be taken concurrently) with a minimum grade of D or PHY 211 (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** PHY 201 or PHY 211
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 203** 🐃 **College Physics II**    **3 Credit hours**
Second half of an introduction to physics for life-science students, using algebra and trigonometry, including electric and magnetic fields, circuits, geometrical and physical optics, atomic and nuclear physics.
**Pre-req:** (PHY 201 with a minimum grade of C and PHY 202 with a minimum grade of C) and PHY 204 (may be taken concurrently) with a minimum grade of C.
**Concurrent PR:** PHY 204
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 204** 🐃 **General Physics 2 Laboratory**    **1 Credit hour**
Laboratory to accompany PHY 203 or PHY 213, focusing on classical E&M, circuits, and optics.
**Pre-req:** (PHY 203 (may be taken concurrently) with a minimum grade of D or PHY 213 (may be taken concurrently) with a minimum grade of D).
**Concurrent PR:** PHY 203 or PHY 213
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 211** 🐃 **University Physics I**    **4 Credit hours**
First half of an introduction to physics for physical science and engineering students, using calculus, and including kinematics and dynamics, force, energy, rotation, fluids, waves, and thermal phenomena.
**Pre-req:** (MTH 229 (may be taken concurrently) with a minimum grade of D or MTH 229H (may be taken concurrently) with a minimum grade of D) and PHY 202 (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** (MTH 229 or MTH 229H) and PHY 202
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 213** 🐃 **University Physics II**    **4 Credit hours**
Second half of an introduction to physics for physical science or engineering students, using calculus, including electric and magnetic fields, circuits, geometrical and physical optics, atomic and nuclear physics.
**Pre-req:** MTH 230 (may be taken concurrently) and PHY 204 (may be taken concurrently) and (PHY 201 with a minimum grade of C or PHY 211 with a minimum grade of C) and PHY 202.
**Concurrent PR:** MTH 230 and PHY 204
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 214** 🐃 **Lab Methods in Physics**    **1 Credit hour**
A laboratory course to accompany Physics 211-213. 3 lab.
**Pre-req:** PHY 213 (may be taken concurrently).
**Concurrent PR:** PHY 213
**Attributes:** Natural Sciences, Core II Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 222 Investigate the Universe**    **2 Credit hours**
A creative laboratory course designed to give students an opporutnity to work with modern research equipment, with ample time to conduct experiments and/or investigate phenomenae of their choosing.
**Pre-req:** (MTH 122 and MTH 127) or (MTH 122 and MTH 130) or MTH 132.
**Grade Mode:** Normal Grading Mode

**PHY 261 Enhancement for Physics I**    **1 Credit hour**
Additional aspects in mechanics (calculus, array vectors and matrices, distributions), to make College Physics 1 equivalent to University Physics 1.
**Pre-req:** PHY 201 with a minimum grade of C or MTH 229 with a minimum grade of C.
**Grade Mode:** Normal Grading Mode

**PHY 263 Enhancement for Physics II**    **1 Credit hour**
Additional aspects in E&M and Optics, Modern Physics, (calculus and multipole functions) to make College Physics 2 equivalent to University Physics 2.
**Grade Mode:** Normal Grading Mode

**PHY 280 Special Topics**    **1-4 Credit hours**
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 281 Special Topics**    **1-4 Credit hours**
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 300 Electricity & Magnetism**    **3 Credit hours**
A course including the study of electrostatics, magnetostatics, electromagnetic induction, introduction to Maxwell's equations and electromagnetic waves. 3 lec.
**Pre-req:** (PHY 203 or PHY 213) and MTH 231.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 302 Electricity & Magnetism II**    **3 Credit hours**
A study of Maxwell's equations and electromagnetic waves, radiation theory, optical phenomena, and electrodynamics. 3 lec.
**Pre-req:** PHY 300.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 304 Optics**    **3 Credit hours**
An intermediate course in geometrical and physical optics. 3 lec.
**Pre-req:** (PHY 203 or PHY 213) and (PHY 405 (may be taken concurrently) or PHY 505 (may be taken concurrently)).
**Concurrent PR:** PHY 405 or PHY 505
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 308 Thermal Physics**    **3 Credit hours**
A study of thermodynamics, kinetic theory of gases, and an introduction to statistical mechanics 3 lec.
**Pre-req:** (PHY 203 or PHY 213) and MTH 231.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 314 Electronic Physics**    **3 Credit hours**
A study of transistors, integrated circuits and their associated circuits. 3 lec.
**Pre-req:** PHY 203 with a minimum grade of D or PHY 213 with a minimum grade of D and PHY 415 (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** PHY 415
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 320 Intro Modern Physics**    **3 Credit hours**
An introductory study of atomic and molecular theories, relativity, quantum theory, and nuclear physics. 3 lec.
**Pre-req:** MTH 230 and (PHY 203 or PHY 213).
**Co-req:** PHY 421
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 330 Mechanics**    **3 Credit hours**
An intermediate study of the fundamental principles of statics of particles and rigid bodies, momentum and energy, dynamics of particles, harmonic oscillations, and wave motion. 3 lec.
**Pre-req:** MTH 231 and (PHY 203 or PHY 213).
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 340 Scientific Computing**    **3 Credit hours**
Introduction to some of the most important tools and techniques in scientific computing, including object-oriented design, version control, and MPI for high-performance computing.
**Pre-req:** MTH 229 with a minimum grade of D or MTH 229H with a minimum grade of D or IST 163 with a minimum grade of D.
**Grade Mode:** Normal Grading Mode

**PHY 350 Biological Physics**    **3 Credit hours**
Physical principles underlying the mechanisms by which living organisms survive, adapt, grow. Will enhance writing skills and strategies. 2 lec - 2 lab. (PR: PHY 203 or 213, and PHY 204)
**Pre-req:** PHY 203 (may be taken concurrently) or PHY 213 (may be taken concurrently) and PHY 204.
**Concurrent PR:** PHY 203 or PHY 213
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 360 Medical Physics**    **3 Credit hours**
Physical principles applied to devise methods for diagnostic and treatment of the human body. Will enhance writing skills and strategies.
**Pre-req:** (PHY 203 with a minimum grade of D or PHY 213 with a minimum grade of D) and PHY 204 with a minimum grade of D.
**Grade Mode:** Normal Grading Mode

**PHY 405 Optics Lab**    **2 Credit hours**
A course in optical experiments encompassing geometrical and physical optics. This course is to be taken with Physics 304.
**Pre-req:** PHY 304 (may be taken concurrently).
**Concurrent PR:** PHY 304
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 408 Thermal Stat Physics**                **3 Credit hours**
Introduction to Thermodynamics, kinetic theory of gases, classical
and quantum statistical mechanics, Bose-Einstein and Fermi-Dirac
statistics, and application. 3 lec.
**Pre-req:** MTH 231 with a minimum grade of D and (PHY 203 with a
minimum grade of D and PHY 213 with a minimum grade of D).
**Grade Mode:** Normal Grading Mode

**PHY 415 Electronics Lab**                     **2 Credit hours**
A course in laboratory measurements encompassing transistors,
integrated circuits, and their associated circuits. This course is to be
taken with Physics 314.
**Pre-req:** PHY 314 (may be taken concurrently) with a minimum grade
of D.
**Concurrent PR:** PHY 314
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 420 Astrophysics**                        **3 Credit hours**
A detailed study of core problems in Astrophysics such as orbital
dynamics, radiation processes, stellar structure and evolution, galactic
dynamics, and cosmology.
**Pre-req:** PHY 213 with a minimum grade of D and MTH 231 with a
minimum grade of D.
**Grade Mode:** Normal Grading Mode

**PHY 421 Modern Physics Lab**                  **2 Credit hours**
Laboratory exercises on modern physics topics encompassing both
experiments of historic significance and current applications. To be
taken with Physics 320, or equivalent.
**Co-req:** PHY 320
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 425 Solid State Physics**                 **3 Credit hours**
The course provides a broad introduction to the structure and physical
properties of solids. It also serves as a basis for advanced courses in
solid state and condensed matter physics.
**Pre-req:** PHY 320 or PHY 442 or CHM 442.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 435 Computational Physics**               **3 Credit hours**
A course on using numerical methods and computer programming
languages for solving complex physics problems and for the simulation
of various physical processes. 2 lec-2 lab.
**Pre-req:** PHY 213 with a minimum grade of D and PHY 330 with a
minimum grade of D and (PHY 445 with a minimum grade of D or
PHY 446 with a minimum grade of D) and MTH 231 with a minimum
grade of D.
**Grade Mode:** Normal Grading Mode

**PHY 442 Quantum Mechanics**                   **3 Credit hours**
A study of waves and particles, the Schroedinger and Heisenberg
formulations, particles in potential fields, scattering and perturbation
theories, and application to atomic and nuclear structure. 3 lec.
**Pre-req:** MTH 335 and PHY 330.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 443 Quantum Mechanics II**                **3 Credit hours**
This is the second part of a two-semester introduction to quantum
mechanics. Emphasis is on applications of quantum theory including
approximation techniques and the study of more realistic quantum
systems.
**Pre-req:** PHY 442 with a minimum grade of D or CHM 442 with a
minimum grade of D.
**Grade Mode:** Normal Grading Mode

**PHY 444 Advanced Laboratory**                 **2 Credit hours**
Developments in producing and detecting correlated photon pairs has
enabled implementation of undergraduate laboratories demonstrating
fundamental quantum mechanical principles. This laboratory
also incorporates fundamental solid state and materials science
experiments.
**Pre-req:** PHY 425 (may be taken concurrently) and PHY 442 (may be
taken concurrently).
**Concurrent PR:** PHY 425 and PHY 442
**Co-req:** PHY 425, PHY 442
**Grade Mode:** Normal Grading Mode

**PHY 445 Math Methods of Physics**             **3 Credit hours**
An introduction to theory of orthogonal functions, curvilinear
coordinate systems, vector and tensor fields, and their applications in
physics. Problems are drawn from different areas of physics. 3 lec.
**Pre-req:** PHY 203 or PHY 213 and MTH 231.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 446 Math Methods of Physics II**          **3 Credit hours**
A second semester of a full year course on methods of solving
problems in physics: calculus of variations, ordinary and partial
differential equations, and special functions with real physics
problems.
**Pre-req:** PHY 445.
**Grade Mode:** Normal Grading Mode

**PHY 447 Mechanics for Teachers**              **4 Credit hours**
An indepth study of mechanics for education majors specializing
in Physics with emphasis on problem solving techniques,
demonstrations, experiments and computer applications. (PR:
PHY 203, MTH 122 and MTH 140)
**Pre-req:** PHY 203 or PHY 213.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 480 Special Topics**                      **2-4 Credit hours**
By permission of department chairman.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 481 Special Topics**                      **1-4 Credit hours**
By permission of department chairman.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 482 Special Topics**                      **1-4 Credit hours**
By permission of department chairman.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 483 Special Topics**                      **1-4 Credit hours**
By permission of department chairman.
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 485 Independent Study**                      **1-4 Credit hours**
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 486 Independent Study**                      **1-4 Credit hours**
**Attributes:** No Textbook Required, Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 487 Independent Study**                      **1-4 Credit hours**
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 488 Independent Study**                      **1-4 Credit hours**
**Attributes:** Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 491  Capstone**                      **1-2 Credit hours**
To give a capstone expeience to physics majors in their junior or senior years by applying the principles of physics to the solution of real life problems. (PR: CSD 203, or 218 and lab).
**Attributes:** Capstone Course, Natural Sciences
**Grade Mode:** Normal Grading Mode

**PHY 492  Capstone**                      **1-2 Credit hours**
To give a capstone experience to physics majors in their junior or senior years by applying the principles of physics to the solution of real life problems. (PR: PHY 491)
**Pre-req:** PHY 491 with a minimum grade of D.
**Attributes:** Capstone Course, No Textbook Required, Natural Sciences
**Grade Mode:** Normal Grading Mode

## Statistics

**STA 150  Foundations of Statistics (CT)**     **3 Credit hours**
A critical thinking course on the basic foundation of Statistics for non-majors, allowing them to better prepare, develop and harness discipline-specific skills.
**Pre-req:** (ACT Math with a score of 17 or SAT MATH SECTION SCORE with a score of 460 or SAT Mathematics Before Mar. 16 with a score of 400 or Placement Math SP20 with a score of 237 or MTH 102 with a minimum grade of C or MTH 102B with a minimum grade of C) and STA 150L (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** STA 150L
**Attributes:** Critical Thinking, Core II Mathematics, Statistics
**Grade Mode:** Normal Grading Mode

**STA 150B  Foundations of Stats-Expd (CT)**     **4 Credit hours**
A critical thinking course on the basic foundation of Statistics for non-majors with algebra review, allowing them to better prepare, develop and harness discipline-specific skills.
**Pre-req:** STA 150L (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** STA 150L
**Attributes:** Critical Thinking, Core II Mathematics, Statistics
**Grade Mode:** Normal Grading Mode

**STA 150L  Foundations of Statistics Lab**     **1 Credit hour**
A lab to provide training in using the SPSS software in Foundations of Statistics for non-majors.
**Pre-req:** STA 150 (may be taken concurrently) with a minimum grade of D or STA 150B (may be taken concurrently) with a minimum grade of D.
**Concurrent PR:** STA 150 or STA 150B
**Attributes:** Core II Mathematics, Statistics
**Grade Mode:** Normal Grading Mode

**STA 225  Introductory Statistics (CT)**     **3 Credit hours**
A critical thinking course in applied statistical reasoning covering basic probability, descriptive statistics and fundamental statistical inference procedures. Parameter estimation and hypothesis testing for variety of situations with wide applications.
**Pre-req:** ACT Math with a score of 21 or SAT Mathematics Before Mar. 16 with a score of 500 or SAT MATH SECTION SCORE with a score of 530 or Placement Math After SP17 with a score of 102 or MTH 121 with a minimum grade of C or MTH 121B with a minimum grade of C or MTH 122 with a minimum grade of C or MTH 127 with a minimum grade of C or MTH 130 with a minimum grade of C.
**Attributes:** Critical Thinking, Core II Mathematics, Statistics
**Grade Mode:** Normal Grading Mode

**STA 326 Applied Statistical Methods**     **3 Credit hours**
Use of statistical packages; introduction to descriptive, probability and sampling distributions; forecasting, inferences concerning one and two samples; simple and multiple regression, analysis of variance and covariance.
**Pre-req:** STA 225 with a minimum grade of C or MTH 229 with a minimum grade of C or STA 150 with a minimum grade of C or STA 150B with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 345 Applied Prob and Stat**     **3 Credit hours**
Statistical methods in scientific/engineering research, with emphasis on applications. Probability modeling, experimental design/survey sampling, estimation/hypothesis testing procedures, regression, ANOVA/factor analysis. Implementation using statistical software such as Excel/SAS.
**Pre-req:** MTH 229 with a minimum grade of C or MTH 229H with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 412 Regression Analysis**     **3 Credit hours**
Determining regression models; deriving parameter estimates using calculus; detailed coverage of tests of assumptions and remedial procedures (transformations and weithted least-squares); multiple and polynomial regression; tests and corrections for autocorrelation.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 413 Experimental Designs**     **3 Credit hours**
Analysis of variance an covariance models with derivations using calculus; detailed testing of model assumptions and remedial measures (as transformations) to yield adequate models; use of various statistical designs.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 420 Nonparametric Statistics**     **3 Credit hours**
Coverage of a variety of nonparametric or distribution-free methods for practical statistical inference problems in hypothesis testing and estimation, including rank procedures and randomization procedures.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 422 Time Series Forecasting**                    **3 Credit hours**
Finding statistical models to represent various time dependent phenomena and processes; coverage of a variety of forecasting techniques, with an emphasis on adaptive, regression, and Box-Jenkins procedures.
**Pre-req:** STA 445 with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 425 Sampling Designs & Estimation**              **3 Credit hours**
Coverage of the theory and applications of a variety of sampling designs; sample size determination; ratio and regression estimates; comparisions among the designs.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 435 Statistical Data Mining**                    **3 Credit hours**
Introduction to statistical learning techniques for analyzing high dimensional data. Topics include data mining strategy, explanatory analysis, predictive modeling techniques and model assessment.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 445 Probability & Statistics I**                 **3 Credit hours**
Probability spaces, conditional probability, and applications. Random variables, distributions, expectation, and moments.
**Pre-req:** MTH 230 with a minimum grade of C or STA 345 with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 446 Probability & Statistics II**                **3 Credit hours**
Statistical inference: estimation of parameters, tests of hypotheses. Regression, analysis of variance.
**Pre-req:** STA 445 with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 464 Statistical Computing**                      **3 Credit hours**
Introduction to the commonly used statistical computing techniques, procedures and methods, with extensive use of R language and environment, and SAS for statistical computing and graphics.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 466 Stochastic Processes**                       **3 Credit hours**
Review of probability theory. Topics include stationary processes, discrete and continuous time Markov chains, Markovian queuing systems, random walks, renewal processes, Brownian motion and Markov Chain Monte Carlo.
**Pre-req:** STA 445 with a minimum grade of C.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 470 Applied Survival Analysis**                  **3 Credit hours**
Survival and hazard functions, parametric and non-parametric methods, models and inferences for survival data, and regression diagnosis.
**Pre-req:** MTH 230 with a minimum grade of C and (STA 345 with a minimum grade of C or STA 445 with a minimum grade of C).
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 480 Special Topics**                             **1-4 Credit hours**
Courses on special topics in statistics not listed among the current offerings.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

**STA 485 Independent Study**                          **1-4 Credit hours**
A faculty, supervised, indvidualized course of study of a topic in statistics.
**Attributes:** Statistics
**Grade Mode:** Normal Grading Mode

# Faculty

**Professors**
Adkins, Akinsete, Brooks, Mitchell, Mummert, Sarra, Saveliev

**Associate Professors**
Horwitz, Karna, Mallick

**Assistant Professors**
A. Al-Aqtash, R. Al-Aqtash, Cuchta, Elkadry, Jung, Miller-Mace, Stapleton, Truong

**Instructors**
Crytzer, Johnson, Mace, Marsh, Subedi, Wright